Supplementary information to "Platinum recycling through electroless dissolution under mild conditions using a surface activation assisted Pt-complexing approach"

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S1: Non-oxide passivation layer removal through cycling

(a) Effect of presence of oxygen

Removal of oxygen decreases the dissolution even when the solution had a convection flow due to nitrogen purging (Fig. S1).

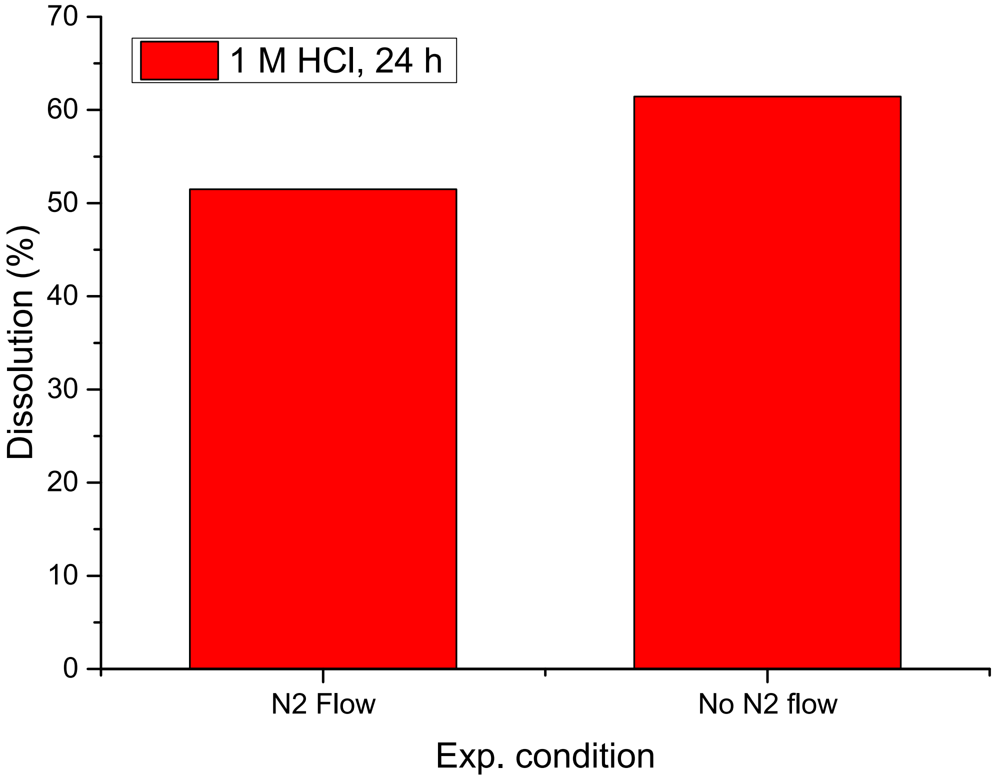

Fig. S1: Pt dissolution with/without N2 bubbling

(b) Cl^- cycling

Activation through H_2SO_4 (dipping the electrode in 1 M H_2SO_4 for ~2 min after every 30 min. holding in 1 M HCl) was performed to observe the effect of Cl^- cycling on the passivation layer. The Cl^- cycling shows marginal increment of the rate of Pt dissolution (Fig. S2)

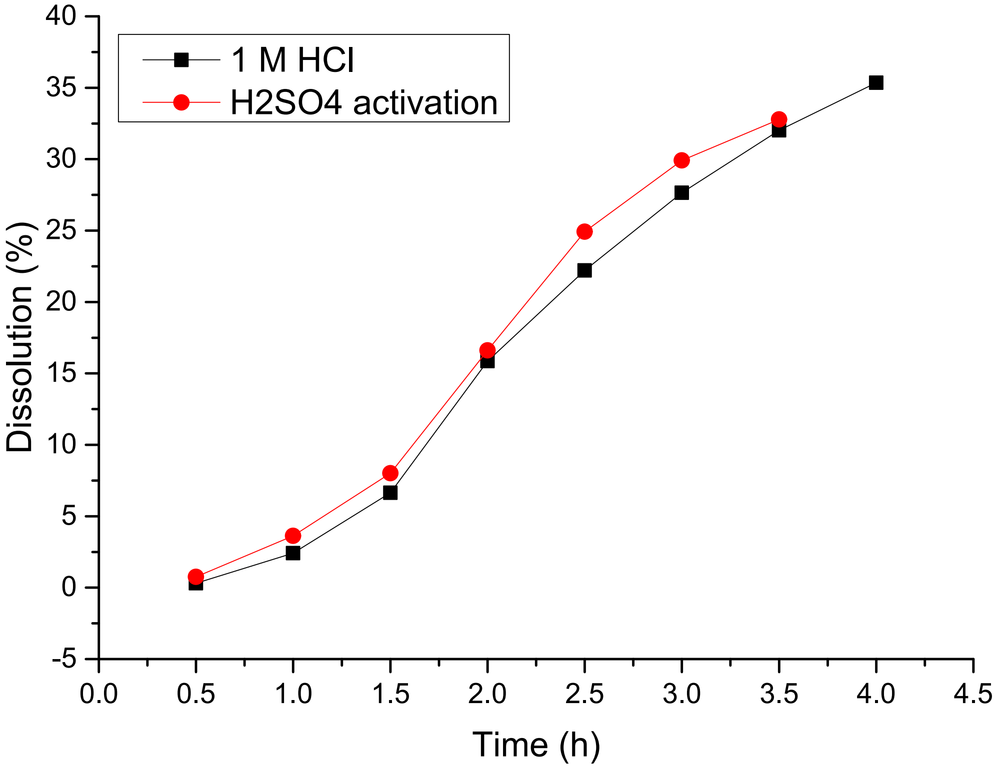

Fig. S2: Pt dissolution with/without Cl^- cycling

S2: Electrochemical observation of passivation layer

Cyclic voltammograms of different post-dissolution study electrodes recorded in 1 M H_2SO_4 between 1.2 and 0.02 V at a scan rate of 100 mV/s (starting potential: 1.2 V) have been shown in Fig S3. The cathodic sweep exhibits a strong peak around 0.4 V, which corresponds to a reduction reaction on the Pt surface. For the electrodes pretreated in 1 M H_2SO_4 or 1 M HNO_3 (1h) the peak corresponds to reduction of the Pt-oxides. However, for the Pt treated with 1 M HCl (dissolution study, 3h), the cathodic peak appears at a comparatively lower potential, indicating stronger adsorption or presence of species with stability higher as compared to that of the surface Pt-oxide layer. This indicates the formation of a non-oxide passivation layer during the Pt dissolution study in 1 M HCl.

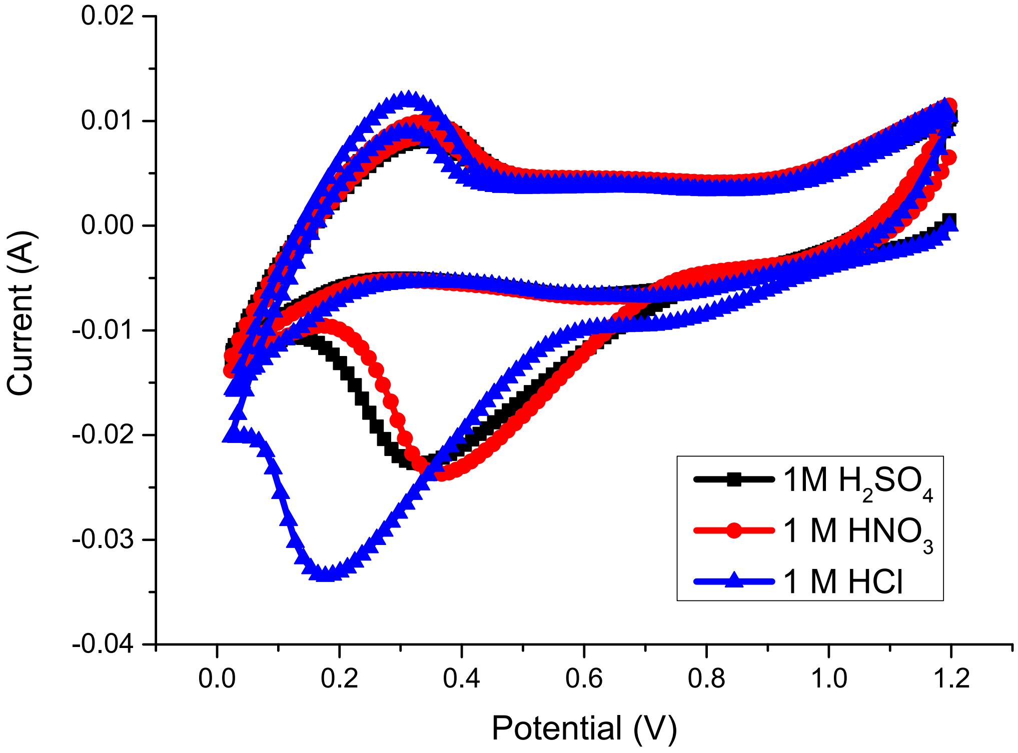

Fig. S3: Cyclic voltammograms of the electrodes exposed to different electrolytes. The voltammograms have been recorded in 1 M H_2SO_4 at a scan rate of 100 mV/s.

S3: EDMC in presence of ethanol in the electrolyte

Presence of species which could get adsorbed on the Pt surface may reduce the rate of dissolution. As an example, Fig. S4 compares %dissolution values for an EDMC duration of 24 h (without activation cycling) in 1 M HCl electrolytes with and without ~1 vol.% ethanol (other conditions being identical to those described under experimental section). Significantly lower %dissolution in presence of ethanol suggested passivation of the surface through ethanol absorption.

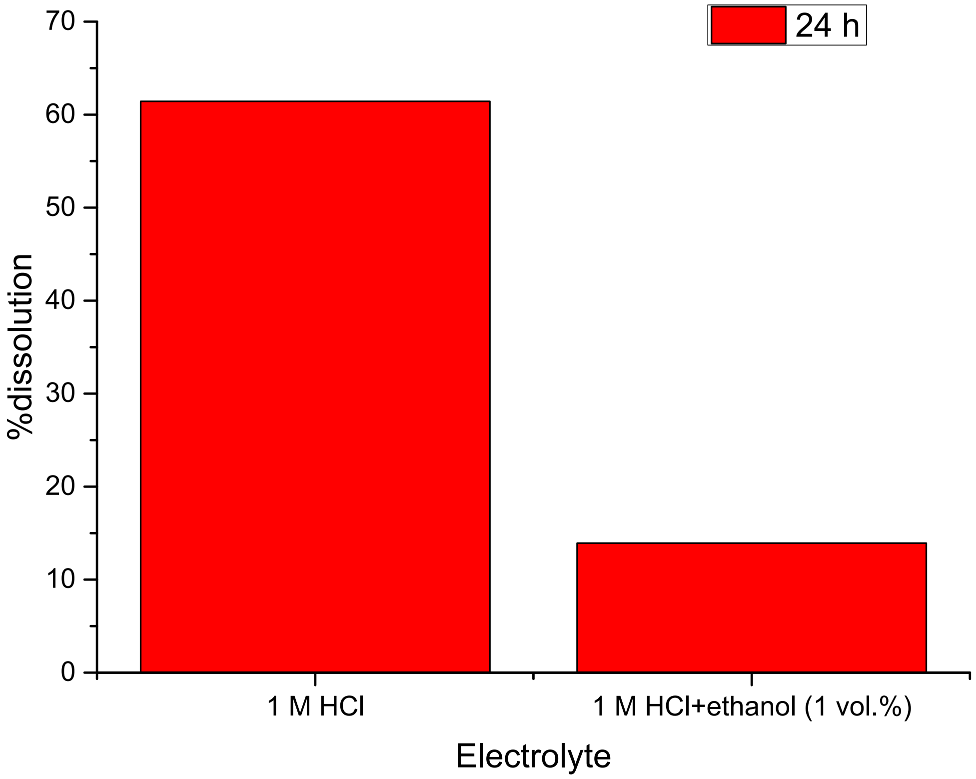

Fig. S4: Effect of presence of ethanol on the rate of dissolution of Pt through EDMC in 1 M HCl.